IRON

MORE GOLDEN THAN GOLD.

A Thanksgiving Discourse,

PREACHED IN MORIAH, N. Y.,

BY

MYRON A. MUNSON, M. A.,

NOVEMBER 28, 1872.

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1873.

At the Union Thanksgiving Service, on motion of Rev. Mr. Craf, seconded by George Sherman, Esq., a request was cordially voted that the following Discourse be presented for publication.

For the profit of the uninitiated, several parts of the subject have been illuminated by copious notes.

A Thanksgiving Discourse

IRON MORE GOLDEN THAN GOLD.

Preached in Moriah, N. Y., Nov. 28, 1872. Printed at the Riverside Press, Cambridge, 1873; pp. 24; ~~price, 10 cents.~~

by Clergyman A. Munson, Mt. Ar

Pp. 24

Comments

"I congratulate you on your happy way of popularizing so much scientific lore."—CHARLES H. MERRILL, *Pastor at Brattleboro', West.*

"This sermon is out of the ordinary run of such productions, being a truly valuable monograph on iron. It is brimful of interesting and suggestive facts, which are presented in such a manner that even the details are not dry, but are readable and entertaining. We commend this 'new departure' to other preachers of Thanksgiving sermons."—*Rutland Daily Herald.*

"A singular discourse. It is an exhaustive though condensed discussion on iron viewed as a divine instrument in civilization, and seems to be well adapted to the peculiar wants of the iron-working community in which it was delivered."—*The Congregationalist.*

"I was recently shown a sermon of yours on *Iron*, which interested me much, and I shall be greatly obliged to you for a copy."—AND. D. WHITE, L L. D., *President of Cornell University.*

"A unique sermon; extremely interesting."—*The Advance.*

"I read his paragraph upon the 'Poetry of Ore' with moistened eyes."—PRINCIPAL DOWLER, *Brighton, Canada.*

"I was delighted to receive your choice and instructive and eloquent discoursing upon a subject 'more golden than gold.' It would have been a real treat to me to sit among your iron-workers and hear. Doubtless you have so gilded their occupation for them, that it should always remain such."— ——— ———, M.A.

"Most elaborate and ingenious. It has the solid metal in it. Only a grand miner could excavate such a weighty mass—'*moles immensa*'—of useful thought and instruction. Into the Gazetteer I at once plunged, and hunted out that iron-wefted realm. Much I wish I could explore it."—LYMAN WHITING, D. D., *Philadelphia*, 1876.

"Brilliant. . . There is nothing to be corrected. I go rather to your discourse to learn, as there is much in it that is new to me," etc.—CHARLES H. HITCHCOCK, *Professor of Geology in Dartmouth College, and State Geologist of N. H.*

"I read it through twice. I was very much pleased with it. I consider it a model sermon."—PROF. EDWARDS A. PARK, D. D., *Andover.*

III.—THE UPRIGHT AND USEFUL CITIZEN.

COMMEMORATIVE OF DEA. SAMUEL LYMAN.

Preached in Southampton, Mass., Jan. 7, 1877. Printed by Weaver, Shipman & Co., 1877; pp. 33; price, 20 cents.

"Colonel Lyman was a type of the class of men who reared the civil and religious institutions of New England. He was conscientious and upright, a man of strong convictions, and, when fully assured of the correctness of his opinions and the rectitude of his conduct, was as immovable as the everlasting mountains among which he drew his natal breath."—*Hampshire Gazette.*

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* Some of the readers of this circular may be willing to see a few words taken from an elaborate criticism of an earlier production, *The Disguises of Satan.* Prof. Phelps wrote of it: "This sermon has certain very positive excellences. 1. It has a positive theology pervading it. 2. It has a positive practical aim. 3. It has sharp and crisp statements of the leading divisions. 4. It has an excellent order of thought. 5. It has pertinent illustrative materials. 6. It has a style which is perspicuous, racy, forcible, various in construction."

DISCOURSE.

"*A land whose stones are Iron.*" — DEUT. VIII. 9.

AN EYE-OPENING LODESTONE.

YOU have seen a magnet attract iron-filings, hug them to its bosom and carry them wherever it might please to go.

Imagine now a colossal magnet, — a magnet of such transcendent energy that it might instantly draw into its embrace every article of Iron within a radius of five or ten miles ; and suppose that during the darkness of this Thanksgiving night — after deep sleep shall have sealed up the senses of mankind — our colossal magnet should begin to shoot across the continent, back and forth, like a shuttle, and swift as a meteor, — silently gathering up all the Iron between Behring Strait and Tierra del Fuego, and at each turn discharging its elephantine load into the Atlantic or the Pacific: what consternation would be witnessed to-morrow morning !

After rising from his bed and dressing himself, one steps to his door: "Aha ! how is this ? " he exclaims —" key gone — yes, and the lock too — and the latch — the very hinges ! Don't see the need of all that ; queerest burglars I ever heard of." He concludes that he may as well go on and kindle a fire. Approaching the wood-house, he thrusts his hand into his pocket for his knife ; it is not there. He goes for the axe ; it also has disappeared. "Well, well," he exclaims, "this is strange ! " With rising excitement, he pushes open the kitchen-door and stands stock-still, his eyes dilating with amazement and his face turning white with terror. That huge kitchen-range — where is it ? and the kettles — and the frying-pans ? and where is the pipe — and the wire that held it in place — and the nails to which the wire was fastened ? There is the waterpail too, without hoop or handle. "Is

this a dream," cries the frenzied man, "or am I mad?" Unable to solve the enigma, he determines to quit the bedeviled place. Rushing to the barn for his horse — behold that wagon — stripped of every tire, every spring, every brace, bolt, band, and rivet! He will go on horseback then: but that bridle — it has neither bit nor buckle. Just now a gale rises: it attacks the house and barn from which every nail has been extracted by the all-conquering lodestone, and instantly the air is ashower with fluttering shingles and sailing clapboards! Away, away flies the maniac to the depot; *mirabile visu!* every car-wheel and axle has evanished, the locomotives have disappeared bodily, and there is not a rail on the track, nor a chair, nor a spike — throughout this boundless continent! Human nature can endure no longer, and our hero swoons to the ground, half-dead with fright.

O how great is our dependence upon this most modest and most commonplace of all the metals! How utterly helpless should we find ourselves without it! Without steam-engines, without stoves, without wagon-tires, without saws, axes, augers, knives, and nails, — the whole business of mankind would come to an absolute pause, and every centre of civilized life would relapse into barbarism or desolation.

RECOGNITION OF A SOVEREIGN GIFT.

Friends, were my supposition of the lodestone to be realized to-night, were you to wake to-morrow morning and find yourselves deprived of the implements, the utensils, the multifarious conveniences which you owe to Iron, what would you not give to recover even a small portion of that which was lost? After spending two or three hours in the effort to reduce an oak or maple into firewood by mauling it with a sharp-edged stone or a slab of copper, — if some kind angel should cleave his way through the air with your axe in his hand, and present it to you, would not your heart swell with gratitude almost to bursting? Or, after spending half a day in the effort to re-fasten the clapboards to your house by means of strings and props, — if some friendly angel should wing his way from the ocean with a keg of nails, and offer them to you, would not tears of joy gush from your eyes, as you fell upon your knees, exclaiming, "Ten thousand thousand thanks, dear angel!" My hearers, have we less occasion to be grateful for a hundred, five hundred, ten hundred

blessings made of Iron, than we should have for one? If we might be almost painfully thankful to an angel who should supply us in a time of destitution with a single edged tool, — how shall we express sufficient thankfulness unto the God of the angels to whom we are indebted for the multitudinous fabrics which are fashioned in Iron! This most useful of metals is doubtless, is verily, a good gift, — it is *perfect:* and there is none to contradict that apostle who declared — "Every good gift and every perfect gift is from above, and cometh down from the Father of lights."

In the audience of those dwelling in a town "whose stones are Iron," [1] whose thoughts and whose hands are occupied with the

[1] Ore was procured from the Cheever Bed as early as 1804. The first opening was made at Mineville, in 1824, when one-half of the Sanford Bed was sold for $200. Ore was discovered about a foot under the surface. An interest was acquired in this property by George Sherman, in 1846, and by S. H. & J. G. Witherbee, also, in 1849. The quantity of ore now raised from these beds each week, is nearly equal to the total quantity which had been raised when Mr. Sherman became an owner in 1846. That total of 6,000 tons had been sold at prices varying from fifty cents to $2.50, at the mines.

Principal Owners.

Witherbees, Sherman, & Co. (S. H. $\frac{1}{3}$ and J. G. Witherbee, $\frac{1}{3}$; George and George Riley Sherman, $\frac{1}{3}$ — firm constituted in 1862) — own the Old Bed, the New Bed, a one-fifth interest in the P. H. I. O. Co., and one-half the L. C. and M. R. R. (7 miles, rising 1400 feet; opened in 1869). Produce, 1872, nearly 140,000 tons.

Port Henry Iron Ore Co. (W., Sh., & Co. $\frac{1}{5}$; Griswold, $\frac{1}{5}$; Burden & Son, $\frac{1}{5}$; Bech, Tower, & Brinsmade, $\frac{2}{5}$), own 21, 23, 24 (in part), rights on the W. end of 25, Fisher Hill Bed, and one-half the R. R.: George Roe, agent. Produce 1872, over 140,000 tons. *Employes*, 400.

Cheever Ore Bed Co. (Mass. men), own Cheever Ore Bed, R. R. to Lake ($\frac{3}{4}$ mile) etc.: Presbrey, agent.

Bay State Iron Co. (S. Hooper, J. H. Reed, and others, of Boston) own the Barton Bed and the Furnace property at Port Henry: Foote, agent.

Witherbees & Fletcher, own the Furnace at 75, etc.

Smith & Co. (M. P. Smith $\frac{1}{3}$, Calkins $\frac{1}{6}$, Burleigh $\frac{1}{6}$, Morrison $\frac{3}{12}$, Colwell $\frac{1}{12}$), own the Smith mine.

Cleveland Co. owns the Pelfishier mine.

Principal Properties.

Old Bed, N. E. corner of 25, owned by W., Sh., & Co.: average yield the six years preceding 1869, 43,500 tons: 250 to 300 men: Tifft, Supt.

New Bed, S. W. corner of 24 (+25), owned by W., Sh., & Co.: average for the above period, 6,700 tons; $\frac{1}{3}$ of it requires separating: 50 to 70 men.

No. 21 ($\frac{1}{2}$ sold in 1829 for $125; not worked till 1846), owned by P. H. I. O., Co.: average, 36,000 tons: Goff, Supt. No. 23, owned by P. H. I. O. Co.:

ore of this metal, and whose hopes, prosperities, and enjoyments, are founded upon it. I can think of no other theme so suitable on a Thanksgiving occasion, as

THE EXCELLENCY — THE PERFECTION OF THIS GIFT OF GOD, THE GIFT OF IRON.

VALUE OF IRON, ARISING FROM ITS PROPERTIES.

The surpassing value of Iron arises primarily, of course, from the properties which it possesses.

Tenacious. — One of its conspicuous properties is tenacity. In-

average, 9,400. No. 24 (excluding New Bed), ib. : average, 9,700. Nos. 21, 23 and 24, employ 250 to 300 men. Fisher Bed, owned by P. H. I. O. Co. : 6,500 tons : ore lean and requires separating.

Smith Mine, owned by Smith & Co. : average, 13,000 : 30 to 40 men.

Barton Bed, owned by B. S. I. Co. : 5,000 to 8,000 : 35 men.

Pelfishier Mine, owned by Cl. Co. : 8,000 to 10,000 : requires separating : 30 to 100 men.

Cheever Bed (sold by Cheever in 1838, for $5,000) ; owned by C. O. B. Co. : about 60,000 tons : 230 men.

Numerous other promising beds and ore lands which cannot here be specified.

Seventy-five Furnace (charcoal), owned by W. & F. : sometimes produced 10 or 11 tons per day.

Port Henry Furnace, owned by B. S. I. Co. : average 32 tons daily. Cheever & Barton ores in equal proportion : in the five years preceding 1869, 58,000 tons of pig-iron, requiring 100,800 tons of ore and 108,000 tons of coal : 135 men.

W. F. Gookin, Esq., to whom the public is indebted for most of the published knowledge respecting the mines, has computed that the amount of ore raised from the ore-beds of Moriah up to Jan. 1, 1869, is 1,100,000 tons. In 1869, W., Sh., & Co., and P. H. I. O. Co., brought to light 120,000 tons ; in 1870, 153,000 ; in 1871, 193,000.

The production for 1872 is nearly as follows : —

Witherbees, Sherman, & Co., P. H. Iron Ore Co.,	280,000
Cheever O. B. Co.,	60,000
Smith & Co.,	12,000
Cleveland Co..	8,000
Bay State I. Co.,	5,000
	365,000

The various mines are pumped and their ores hoisted by steam-power.

More than one-tenth of the Iron produced in the United States is mined in Moriah.

deed, wrought-iron opposes a greater resistance than any other substance to a force applied to draw it asunder.[1] Platinum is nearly as strong, but it is a very scarce metal. A rod of Iron has tenacity equivalent to one-and-a-half such rods of copper or silver, two of gold, three of boxwood, or five of oak.[2] A bar of Iron one inch square will sustain a weight of thirty tons, while a bar of steel will sustain a burden of sixty tons. Iron wire one-thirtieth of an inch in diameter, has borne a load equivalent to ninety tons to the square inch[3] without breaking.

Firm.— Cast-iron, however, is better than wrought-iron for columns. Indeed there is no other material in common use which is so well adapted to resist a compressive force. Granite is only one-sixth as strong, Italian marble one-seventh, freestone one-tenth, and brick is still feebler.

Ductile. — Wrought-iron, that is Iron which has been purified from carbon, is ductile, like wax ; by which we mean that it is capable of being drawn out into wire, of any desired length or fineness. This valuable property is called its ductility.

Malleable.— The same kind of Iron is capable of being extended by hammering or rolling, into plates and sheets. At the Breslau Exhibition,[4] there was shown a hundred weight of iron rolled to such thinness that two hundred and fifty leaves of it would make a pile only one inch thick. There might have been printing done upon those sheets ; they were as flexible as paper. Indeed a quantity of them were bound up in the form of a book.

When malleable Iron[5] (another name for wrought or bar Iron) is heated to redness, it becomes very soft and pliable, and is easily worked under the hammer.

Weldable. — But its most remarkable property, according to Professor Johnston, and a property to which its usefulness in the arts is very much owing, is its capacity of being welded, — that

[1] My authorities all agree to this. But I find one of them is so inconsistent as to say in another place that the tenacity of nickel is greater than that of Iron, and in another place that the tenacity of cobalt is nearly twice that of Iron.

[2] Three of cast-iron, five of pine or beech, seven of mahogany.

[3] Area of section.

[4] In 1852.

[5] Malleable Iron is now employed more extensively than cast-iron. Any degree of rigidity may be obtained by the employment of a tubular or cellular structure, while in many cases two-thirds may be saved in the weight of material.

is, two pieces may be brought together at a white heat and hammered into as perfect a union as though they had originally constituted but one piece. It is a curious fact, though, that the welding property of the metal is destroyed by the presence of a slight tinge of a certain element: if Iron has only three parts of sulphur in ten thousand, it is not weldable. There is no other metal[1] to which welding can be usefully applied.

Moldable.— The carburetted form of this metal — in which there is five per cent of carbon — is called cast-iron.[2] It is easily fusible, and when fused is very fluid so that it may be run into molds of various patterns with entire success. The tendency of the fluid to expand in cooling, serves to enhance the nicety with which the fine lines of the mold are filled, and thus contributes to the perfection of the casting.

We are not likely to exaggerate the value of this property of Iron. Observe how it is applied, in a single city of the Empire State, to the production of stoves. The utensils of this kind which are sent forth each year from the foundries[3] in Albany,[4] if drawn out northward in a single compact line, would extend along the Hudson and Lake Champlain as far as the Ausable river.

Temperable.— A very precious form of Iron is that which contains about one-and-a-half per cent of carbon, and is known as steel. It resembles cast-iron in hardness,[5] and in that it may be cast,[6] while it resembles malleable Iron in strength, and in that it may be forged. Its prime specialty, however, is its susceptibility of being *tempered*, that is, made hard or soft at pleasure. You may forge and temper it to an *edge*, and this is no doubt the blossoming estate of the metal. Every knife, every plane, every auger, every saw, — every cutting instrument whatsoever, — bears witness to the transcendent value of this property of Iron.

[1] The exception of platinum is unimportant.

[2] Unknown to the ancients. Whether they made steel or wrought-iron by their processes, was a matter of chance. Cast-iron was first regularly made in the fifteenth century.

[3] In *foundries* cast-iron is melted, and molded into various utensils; while in forges, malleable Iron is heated, and fabricated by hammering. A hammer at the Mersey Iron Works in Liverpool weighs nearly thirty-three tons!

[4] Over a dozen years ago, 200,000 annually.

[5] Harder than any other substance except diamond and crystallized alumina.

[6] Fuses at 2192° — 2552° F.

Magnetizable. — The other various properties of our metal need not be mentioned in this place, — unless we should add perhaps that Iron is attracted by the magnet.[1] One of the Plinies, a thousand eight hundred years ago, related a curious proposal that had been invented in regard to the Iron statue of Arsinoë, sister of Ptolemy Philadelphus. This proposal was to suspend the statue in a temple by the equilibrium of several magnets acting against gravity. Of course the image hovering thus in the air — without any visible means of suspension, would *seem* to be upheld by a miracle.

It is this obedience of Iron to the magnet which indicates the presence of ore to a surveyor, by causing the needle of the compass to decline from the magnetic meridian, — as was the case at Mineville in 1810. Following a clue furnished in this way, one of your townsmen — within the memory of the youngest of you[2] — went to a sandy knoll in a pasture, where there was not the slightest show of Iron upon the surface, and excavated a shaft through one hundred feet of hard-pan before even a very thin vein of ore was reached ; and then it was not until forty-six feet of rock had been penetrated that the plucky explorer found that extensive and precious vein of ore which had attracted the magnetic needle so remarkably.[3]

VALUE DEPENDING ON ABUNDANCE AND DIFFUSION.

Without lingering longer amidst the curious and serviceable properties of Iron, I proceed to observe that the surpassing value of the metal arises, secondarily, from its vast abundance and the universality of its diffusion.

Abundance. — Its abundance is a grand element of value. Small quantities are insufficient for large uses. Diamond would

[1] It is itself susceptible of being rendered magnetic (permanently in some forms, as steel and black oxide), a property possessed by no other metal except nickel. The natural magnet or lodestone (leading stone, the stone that leads, or guides) is an oxide of Iron.

"The ancients regarded the magnetic power of Iron as miraculous." — Hunt's *Poetry of Science.*

[2] Smith's mine was opened in June, 1866.

[3] At the surface, the dip-needle of the mining-compass was drawn down from the horizon 37½° ; at 15 feet below, it came down to 55° ; and thenceforward it declined 1° each foot until it became vertical (marking 90°.) A vein of ore was found 14 feet thick, and a yard beneath it, another 10 feet thick.

be an elegant building-material if there were a competent supply of it. Gold is quite as malleable and quite as ductile as Iron ; but it would not go far towards supplying the world with engine-boilers, stove-pipes and wire-cables. If Iron were as scarce a metal as cadmium, its various admirable properties would be of no worth whatever. According to the chemists, cadmium,[1] if there were enough of it, would be useful in the arts, and palladium[2] would be very useful ; but their great scarcity renders them useless.

The deposits of Iron ore, on the other hand, are immense. This best of all ores — better than copper, better than silver, better than platinum,[3] better than gold — this best of all ores is offered us not by the grain, nor by the nugget, nor by the boulder, but by the mountain. There are twenty-three thousand tons of gold[4] in the hands of the human race ; but each year there is deported from the township of Moriah ten times that quantity of metallic Iron,[5] while the United States produces eight and one-half times as much as Moriah, and the world produces seven times as much as the United States. The amount of new Iron consumed annually — fourteen millions of tons[6] — outweighs six hundred times

[1] A white metal, much like tin.

[2] A white, hard, very malleable and ductile metal, which is susceptible of fine polish.

[3] A metal of silvery complexion. It obstinately resists fire and chemical action, and is therefore excellent for crucibles and retorts. Platinum is the heaviest substance known (except *perhaps* iridium), being $21\frac{1}{2}$ times as heavy as water, and nearly three times as heavy as Iron. (Cast-iron weighs about four ounces to the cubic inch.) Its value is five times that of silver, not quite one-half that of gold. It is obtained from South America, Russia, and Borneo.

[4] An obliging note from that eminent political economist, the Honorable Amasa Walker, furnishes me with the data for this interesting fact. The amount of gold existing prior to 1848, he estimates (with Humboldt) at 10,000 millions ; the amount produced since he computes to be 2,500 millions ; total, $12,500,000,000. As a dollar contains $25\frac{8}{10}$ grains, the weight of all these millions would be $23{,}035\frac{5}{7}$ tons.

[5] 237,000 tons (=65 per cent of 365,000 tons of ore.)

[6] Yield this year, of which Great Britain produces one-half, 7,000,000 tons, and the United States, one-seventh, 2,000,000 tons.— *Pop. Sc. Monthly*, July, 1872.

In 1871, Great Britain produced 6,500,000 tons, France (with plenty of ore but little coal) 1,350,000 tons, Germany 1,250,000, Belgium 896,000, Austria 450,000, Russia 330,000, Sweden and Norway 280,000, Italy 75,000, and Spain 72,000. — Ryland's *Iron Trade Circular*.

As to the United States, "the greater part of the manufacture must event-

the gold possessed by all the nations of the earth. So vast is the abundance of this mineral.

Diffusion. — I mentioned as another element in the value of Iron, the universality with which it is distributed throughout the earth. It is gratifying that an article imperatively needed by everybody should be found everywhere. No matter that diamond and platinum are restricted to a few localities; we can spare them both, and should we require them, they are easily transported. But the iron which should supply our need would be too ponderous to be brought from the other side of the world, and accordingly the Great Provider has buried deposits of it within easy reach of every community on earth.

Besides these rich deposits which are worth mining, observe that there is an unlimited quantity of ferruginous matter which will never be worked; for this great globe is peppered with Iron from centre to circumference. You may find it in every longitude and every latitude, in every mineral formation — all stones and all soils, in many springs of water, in almost every plant and in the blood of every animal.[1] It is in the marble columns[2] of the Capitol at Washington, in the plates of mica through which my coal-fire is shining, in the sugar-beets[3] we saw swaggering in your garden last summer, and even in the green spectacles worn by your weak-eyed uncle. Wherever yellow appears in stone, sand, soil or loam, there is photographed the hydrated sesquioxide of Iron, or brown hematite; and from every cliff of red chalk and red sandstone, the anhydrous sesquioxide of Iron unfurls its banner of blood.[4]

Must we not admire and bless The Hand which has constituted Iron with *properties* of such eminent and indispensable[5] utility,

ually establish itself in the valley of the Mississippi, where vast deposits of coal and iron exist." — Wm. Fairbairn, C. E., LL. D.

[1] "It is the only metal which is not injurious to the health, and the only metal which forms a never-failing constituent of the body."— Stöckhardt.

[2] Carbonate of protoxide of Iron; $\frac{365}{1000}$ of one per cent!

[3] Professor Goessmann in *Report of Massachusetts Agricultural College*, 1872.

[4] Nearly all green stones and black stones owe their color to protoxide of Iron.

[5] As early as 1622, "an iron work was set up" on James River, Virginia.

In 1731, Col. Dunbar, surveyor-general of His Majesty's woods, reported to his superiors the following: "They have 6 furnaces and 19 forges for making iron in New England."— *New Am. Cyc.*

which stored the chambers of the earth with it in such *profusion*, and moreover *distributed* these beneficent stores amongst all the communities under heaven.

VALUE RESULTING FROM ITS FURTHERANCE OF LABOR.

I have reserved, hitherto, a very interesting element in the value of Iron, — perhaps it might not occur to you without a little reflection ; I mean its opening a wide and profitable field to human labor. By the sweat of the brow we eat our bread ; and this arrangement, for beings who are *depraved*, is by no means a cursed one : it is full of benignity, ministering to health, contentment, the mind's strength and the soul's virtue. Compare the welfare of the industrious races of mankind with the welfare of those that are indolent and idle. But however this may be, as simple matter of fact we must all find work to do ; and I repeat what was stated a moment ago, that the metal which we have under notice, opens a wide and profitable field to human labor. The Divine Hand has not stored the earth with coffee-mills, and hammers, and chisels, and bolts, and nuts, and screws ; what you find there is a mass of rock.

Metal to be Converted into Utensils. — I doubt whether any other material is so much enhanced in price by the labor bestowed upon it. Here, for example, is a bar of Iron worth $5 ; in the form of horseshoes, it is worth at least $10 ; in the form of needles, $55 ; in penknife blades, $3,300 ; in balance-springs of watches, a quarter of a million of dollars.

Ore to be Converted into Metal. — But there is more to say. That bar of Iron which was wrought into these fabrics, was not found in the mine. The iron-stone which it represents was not worth $5. Sixty-six per cent. of that $5, and probably seventy-five per cent., was imparted to the metal by labor.[1] Let us see.

If there can be shown any specimens of pure Iron native to our globe, they are exceptional and insignificant. Ignoring these doubtful existences, you will recognize the very limited quantities of ferruginous *metal* which have been found upon the earth's surface, as of meteoric origin — having fallen from the sky.

[1] "Though iron is the most common of the metals, it is by far the most difficult to obtain in a state fit for use." Brande.

Compare Homer's epithet, πολύκμητος, much-wrought.

Kinds of Ore.—The rocks in your famous ore-beds [1] are *compounded* of metallic Iron and several other ingredients — oxygen being the chief.[2]

This particular compound is called the magnetic oxide ; it is named *magnetic* because that the natural magnet or lodestone is of this species. The magnetic oxide is the richest of all ores. Indeed it is chemically impossible that any compound should produce a higher percentage of Iron.[3] Next in importance [4] are the specular ore [5] and brown hematite.[6] These are all oxides of the metal ;[7] how perfectly they disguise all their sterling qualities ! — mere rocks,[8] — and in this form utterly useless ex-

[1] The term *ore* is applied properly only to those mineral bodies which contain so much metal as to make it worth while to smelt them, or reduce them by fire to the metallic state : they must contain 25 or 30 per cent.

[2] Oxygen constitutes nearly half of the earth's crust (45 per cent. in weight).

[3] Cannot yield more than 72.4 per cent., while specular cannot exceed 70.

[4] Magnetic and specular ores accompany each other in the same formations, often in the same hills.

In the Adirondack region, the magnetic ores form very extensive beds.

The great beds on Lake Superior and in Missouri, are chiefly specular.

The sources of Iron in Pennsylvania are miscellaneous — magnetic ores, hematite, fossiliferous, etc.

Clay iron-stone (an impure carbonate of Iron), is the sole dependence of the furnaces in England. It yields from 30 to 33 per cent. of Iron, rarely 40 per cent. The ore is often interstratified with coal. In Pennsylvania and elsewhere, there is a similar interstratification of ore with coal.

[5] Specular ore — so named because the faces of its crystals often shine like a *speculum* or mirror — is the sesquioxide of Iron. It is sometimes called red hematite. The blood-stone, used in jewelry, is a form of it.

[6] Brown hematite is the same as the above with water added ($Fe^2O^3 + 3$ HO). This hydrated hematite is of the same constitution as iron-rust. It is employed in medicine as an antidote to arsenic. "In a few instances diamonds have been found attached to loose pieces of brown hematite."

[7] "Iron is generally combined with oxygen, and occurs less frequently as a carbonate or sulphuret."— Loomis.

The compounds of Iron and sulphur are called iron pyrites ; they exist in enormous quantities, but are not worked as ores. They yield however the sulphate of Iron (green vitriol or copperas), which is so extensively used in the arts. It is a constituent of writing-ink.

[8] Of which it takes from 2 to 3 tons, say $2\frac{1}{2}$ (*Pop. Sc. Month.*), to make one of Iron. A ton and a half of Moriah ore yields a ton of Iron. The Old Bed and Twenty-one, in the blast furnace, yield 65 per cent. of iron.

cept perhaps as material for stone-wall. The problem is to divest the metal of the foreign elements which are combined with it. [1]

Process of Reducing.—Examine your own magnetic oxide. Take a chip from the Old Sandford Bed : what is it composed of? About 72 per cent. of it — not quite three-quarters — is metallic Iron ; about 27 per cent. is oxygen ; and then there is a little silica and phosphorus — less than one per cent. The question is — How to persuade that oxygen to let go of the Iron and leave it? — Answer : First make it good-natured by treating it with melting tenderness, and then bring into its presence another element which it loves better than it does Iron, and with which it shall immediately elope. In plainer speech, heat the ore to the point of fusion, when the oxygen of the ore will prefer the carbon of the fuel, and having rushed into its embrace, the couple will hurry up the chimney in the guise of carbonic oxide.[2] The next question is — How to coax that silica and phosphorus to come away from the Iron? This is effected by the same general process. While the ore is at the melting-point, introduce to the silica and phosphorus some element which they like better, such as lime, when they will abandon the Iron and embrace the lime,— running off with it as a glassy slag. This slag being lighter than the molten Iron, will float on it, in the manner of cream.[3]

The reduction of metal from the ore is now usually effected in a blast-furnace.[4] Successive charges [5] of coal [6], ore and lime-

[1] The essential constituents of ores are Iron and Oxygen. There are also associated with them, two, three, or several other ingredients, such as silica, alumina, lime, phosphorus, sulphur, and manganese.

[2] Becomes carbonic acid at the mouth of the furnace.

[3] Serviceable in protecting the melted Iron from the atmosphere, which would otherwise oxidize a considerable quantity of it.

[4] The high blast-furnace was introduced in the 16th century. The earlier, now obsolescent, process was that of the *bloomary*, which deoxidized the ore by heating it without fusion, and then hammering it into a bloom, — the product being malleable Iron.

In 1850, there were as many as 200 bloomary-fires in Essex and Clinton counties — 21 of them under one roof. The capacity of each fire is one ton a day.

[5] The weight of the coal slightly exceeds that of the ore, and the weight of the flux varies from $\frac{1}{8}$ to $\frac{1}{3}$ of that of the ore.

[6] The tons of pig-iron made with various kinds of fuel in the United States, at periods of 15 years apart, were as follows :

	Charcoal.	Coal and Coke.	Anthracite.
1854,	342,000	54,000	339,000
1869,	392,000	553,000	971,000

stone are thrown in at the top [1] until the furnace is filled, when the fuel is kindled, and powerful [2] blasts [3] of heated air [4] are driven [5] into the midst.

The quantity of air forced through the materials in a furnace is incredibly great — outweighing the entire burden of ore, coal, and flux! There are stacks which receive fifteen tons every hour. As fast as the ore is reduced, the furnace is replenished with new strata of coal, ore, and flux.[6] The metal is drawn off two or three times in twenty-four hours and run into rude moulds. The article we have now obtained is cast-iron.[7] (It is commonly known at this stage as pig-iron.[8]) Do you wish to cast a stove or a car-wheel? Here is your material.

Converting Cast-iron into Malleable Iron. — But this product, after all, is not pure Iron. You cannot forge it into a horseshoe; it will not soften at a red heat, and it is brittle.[9] What is the mischief? The metal is permeated with carbon. But you thought it had been purged of all the impurities which the ore contained. It had indeed: but during the process, it absorbed five per cent. of *carbon* [10] from the coal that was in the furnace.

[1] Other layers are added as the burden sinks down.

[2] In the large anthracite furnaces, the pressure of the blast is often 8 pounds upon the square inch.

[3] Homer represents Hephæstus as throwing the materials from which the shield of Achilles was to be forged, into a furnace urged by 20 pairs of bellows.

[4] By employing air heated to 600° or 800°, only one-third or one-fourth as much fuel is required, and ore can be reduced three times as fast.

[5] The air — conducted through a series of pipes placed above the furnace, so as to be heated by the blaze that constantly issues from the top — is forced by the piston into a large reservoir, whence its own elasticity causes it to flow in a regular unintermitting stream into the furnace.

[6] In this manner the smelting often continues uninterruptedly for five or six years.

[7] As we are considering that element of value which labor imparts to Iron, it should be mentioned that the maximum of strength, elasticity, etc., is arrived at only after the metal has undergone twelve successive meltings.

[8] Origin of the term pig-iron: The blocks of Iron formed in the large main channels of sand were called sow-metal, and the smaller blocks formed in smaller side channels communicating with the large ones, were called pig-metal — from the fancied resemblance of such a cluster of blocks to a sow and her litter of pigs. — *Pen. Cyc.*

[9] Though cast-iron acquires a certain degree of flexibility and even of malleability on exposure for several days with iron-scales to a red heat.

[10] Where the carbon is in perfect chemical combination, the metal is white and lustrous, and on account of its tenacity and difficulty of fusion, it is un-

Having ejected this intruder, we shall have the metal in its purity.[1]

Suppose it to be already in a reverberatory furnace (a puddling-furnace) at the point of fusion ; the sheet of flaming gases is reflected downwards from the arch upon the molten mass till the carbon is burned out,[2] when the product is cleansed by squeezing and finally rolled to give it fibre [3] and shape. This finished article is wrought-iron.[4]

Converting Cast-iron into Steel. — But we do not yet find a material which may be converted into edge-tools. For such a use this malleable Iron would scarcely excel lead. It will be remembered that the cast-iron which we put into the reverberatory furnace contained five per cent. of carbon ; had we burned out only three and one-half per cent. of this substance, the product resulting [5] might have been so tempered as to take and keep an edge.[6] However, that metal which was converted into wrought-

suited for casting, but may be employed in the preparation of wrought-iron and steel. Where the carbon is only partly dissolved, the metal is grayish, and at 1832 F., it fuses to a mobile liquid mass which flows readily into all parts of a mold. This gray metal does not admit of being worked in any other way, as it is extremely hard and brittle.

[1] Though this purity is not absolute. Malleable Iron has from $\frac{1}{4}$ to $\frac{1}{2}$ per cent. of carbon, a trifle of silica, etc. Really *pure* Iron when polished is of a white color. There is no Iron in use which is purer than the fine wires of piano-forte cords.

[2] As in the blast-furnace we fed the oxygen (of the ore) with carbon that it might become carbonic oxide, so in the reverberatory furnace we feed the carbon (of the cast-iron) with oxygen that it also may become carbonic oxide. This puddling operation requires from $1\frac{1}{2}$ to 4 hours.

[3] Naturally of a granular texture, Iron is made fibrous and tough as it is wrought under the hammer or the roller.

[4] Does not fuse until 2912° F.

[5] *Crude* steel. *Blistered* steel is obtained by filling an iron box with bar Iron and powdered charcoal, and then maintaining the whole for several days at a red heat. Both kinds are rendered uniform by hammering (tilted steel) or re-melting (cast-steel).

[6] "Articles of steel are generally forged and cooled quickly. They are then heated a second time to a temperature which is the higher the softer the steel is intended ultimately to be, and from this temperature they are permitted to cool slowly. This is called the tempering of steel. By varying the temperature to which it is raised, and the rapidity with which it is cooled, it may be obtained of all degrees of hardness." — Geo. Wilson, F. R. S. E.

After cutting instruments have been fabricated they are so annealed as to acquire certain colors, thus (proceeding from harder to softer): the finest

iron by the expulsion of all its carbon may still be converted into steel [1] by reversing the process and adding to it one and a half [2] per cent. of carbon.

Mr. Bessemer's method of converting cast-iron into malleable Iron and semi-steel, with no other fuel than the carbon contained in the Iron, is wonderfully ingenious, though very simple, as the greatest things usually are.[3] It must gradually [4] revolutionize this department of iron-making.

Do you not find yourself admiring the curious and beneficent adaptations which are displayed in the complicated chemistry and metallurgy of Iron? Do you not find yourself admiring the human mind — so fearfully and wonderfully constituted that it may discover these subtle and intricate laws of matter? Do you not find yourself admiring that so attractive a field should have been opened to human skill and industry? Such admiration, it seems to me, ought easily to mutate into praise and thanksgiving.

Mining and Moving Ore. — But I have not quite dismissed that view of Iron which regards it as opening a wide and desirable field of labor. We have taken the ore at the furnace when it was worth from four and a half to five and a half dollars, and converted it into usable Iron when it was worth from forty-four to one hundred and fifteen dollars [5]; and we have taken the Iron

knives, pale yellow; pen-knives and razors, golden yellow; axes, chisels, scissors, and ordinary knives, brown to purple-red; swords, gimlets and watch-springs, bright blue; the blades of saws, dark blue. — F. Schoedler, Ph. D.

[1] See note above, on Blistered Steel.

By sprinkling ferrocyanide of potassium upon red-hot agricultural implements, etc., a coat of steel may be formed on the surface, imparting to them a great degree of hardness and durability. — Stöckhardt.

[2] Authorities differ: Wilson, $1\frac{1}{2}$; N. Am. Cyc., 1 to $1\frac{1}{2}$; Schoedler, 1 to 2; Johnston, seldom 2; Stöckhardt, 2 to $2\frac{1}{2}$.

[3] Bessemer's process was patented in 1856. The principle of it is to burn out the carbon of the melted crude pig-iron, as received from the blast-furnace, by blowing atmospheric air through it, the chemical operation evolving the heat required to keep the mass in fusion. The process requires only thirty or thirty-five minutes.

[4] There are several of the Bessemer converters in the United States, (seven works in 1868), and several times as many in Europe (at least eighteen in England, and in other countries, thirty-seven).

[5] *Bulletin of American Iron and Steel Association,* October, 1872. [Being remarkably well known and remarkably uniform in character, "Scotch pig" is the standard by which the price of Iron is commonly quoted.]

and manufactured it into various utensils, when it was worth thousands of dollars, perhaps tens of thousands. But there is much before this.[1]

I should smile, men of Moriah, to find myself explaining to you how the ore of Iron is mined, raised from the pit, assorted, and conveyed to the wharf, depot or furnace. What I could tell you about this would contrast with what you could tell me, as an alphabet contrasts with an epic poem. You — who from boyhood have been familiar with those five acres of ore-lands at Mineville which were formerly sold [2] for fifty cents per acre, and are now worth — how many millions? I am not to teach *you* how to loosen a body of ore, or how to load a pile. It is enough for me to recognize — thankfully — that hundreds and hundreds of our people find very remunerative employment in mining, handling, and removing the contents of the ore-bed.

The Poetry of Ore. — But stay a moment, brother-workman: have you the art of conjuring up pleasant thoughts about those dark, horny, heavy fragments of rock which sometimes vex you, sometimes wound you, oftentimes weary you? That load of five tons and a half upon which you are seated, — do you see anything written in those lumps? The thoughts of the All-knowing One in regard to them are full of entertainment. If we might read, as God does, the careers to which they are destined, — very thrilling might be those stories. Does this lie beyond the sphere of our knowledge? Then it lies in that sphere over which imagination is to preside.

Perhaps a portion of that ore may be converted into a minnie-rifle and guide a ball to the heart of some general, who was just anticipating the huzzas of victory; perhaps a portion of it may cover the string of a piano whose music — under the touch of another Beethoven — shall waft the spirit of a dying sister into the Beautiful Land; perhaps a portion of it will appear in the façade of some palatial dry-goods store, on Broadway or Chestnut Street; perhaps a portion of it will form the needle of some pale, sad, weary sewing-girl whose tears gush at the fiend's suggestion of a gilded and giddy life outside the precincts of virtue; perhaps a portion of it may be transmuted into a dye which shall give complexion to the coat of a Senator, while he expounds the

[1] M. P. Smith, Esq., sells his ore for $1.00 per ton in the vein.

[2] Most of them. Watson's *History of Essex Co.*

Constitution ; perhaps a portion of it will be taken as a medical prescription, rekindling the flame of a life that had begun to flicker ; perhaps a portion of it will be fashioned into a pen with which some timid lover shall write — "Will you?" while perhaps another portion may be converted into the ink with which a maiden shall write her sweet — "I will" ; perhaps a portion of it may be molded into an idol, sold to a Hindoo, and have prayers offered to it ; and perhaps yet another portion of it may be fashioned into a screw which shall bore its way through a little coffin-lid into the heart of a mother, while she sobs — "O my baby!"

Brother-teamster, your load of ore is full of stories — romances, comedies, tragedies — if you would but open your ears and listen.

But it is time to find

AN END

to these Studies.

General Thankfulness for the Multiform Blessing. — We have admired the chemical relation of Iron to oxygen, silica and carbon — a divine contrivance ; the diversified and convenient properties of the metal — divine inventions ; its multifarious and indispensable uses — divine provisions ; its incomparable abundance and world-wide diffusion — divine arrangements ; its call to lucrative labor — a divine intention : and in admiring it all we have simply admired the DIVINE : do we not find ourselves grateful and thanks-giving to a Divinity that is so beneficent?

Particular Thankfulness for the Iron-kings. — One or two other motives to gratitude suggested by this subject, I cannot wholly neglect. I have already referred to operations in Iron as affording the multitude employment, a handsome livelihood, and the opportunity of accumulating something which may be put at interest or invested in some profitable way. I am now to mention, as a matter for thankfulness, that doing business in Iron yields some not only a competence, but abounding wealth. Are there twenty of you, my hearers, with large, ox-like hearts — generous and philanthropical? I should deem it cause of thanksgiving, if you might every one possess a source of wealth like *Twenty-one* or *Twenty-five.* It is on these large accumulations of property that we rely for the promotion of the general welfare in ways that are expensive, too expensive for people of ordinary means. Would

the public good be subserved by voluntary expenditures for a lengthened side-walk, or the procurement of local telegraphic facilities, or the painting of a weather-worn meeting-house, or the purchase of an excelling church-organ, or the reconstruction of an ill-conditioned school-building, — it is very comfortable to remember that there are leisure funds at the next door. And when a public library is brought into existence, or when a house of worship is erected, or when a superior institution of learning is founded and endowed, to whom are we likely to be indebted for the benefit? Very frequently, in the main, to some one of the money-kings.

And while *we* give thanks to God for the rich man's ability to do splendid things, and for his disposition to do them, let the rich man also give thanks for his opportunity to be magnificently useful. He is among those who are privileged supremely. Does he found a great college or university? He not only opens a fountain of blessing to thousands of youth who are thirsting for knowledge, and to tens of thousands who are yet unborn, but he BUILDS TO HIMSELF A MONUMENT of the most honorable and enduring description.

The other day I turned to one of my Cyclopædias, a large work in sixteen volumes, and sought the proper noun, Matthew Vassar. I found it: a liberal space was devoted to the celebration of this name: Why? Its owner had invested[1] over $400,000 in the founding and endowment of Vassar College. Had he done with that property as many would have done, he would scarcely have been known beyond the limits of Poughkeepsie, and in twenty years Poughkeepsie herself would have forgotten him; whereas now — scarcely nine years from the opening of the institution that he founded, his name is known from ocean to ocean, aye, and beyond the oceans, and a hundred years hence, two hundred years hence, the name of Vassar will be more familiar and more renowned than it is to-day.

I turn the leaves of my Cyclopædia in search of the name of Samuel Williston. I find it. What has he done that should entitle him to such distinction? He has put a quarter of a million of dollars into an academy of the highest rank — Williston Seminary, and has besides made larger donations to Amherst College than any other man has.

[1] At the outset; by his will there were added more than $150,000; indeed, he is said to have spent upon the institution "nearly a million of dollars."

Once more I turn the leaves of my Cyclopædia in search of the name of Ezra Cornell. I do not find it. Why, has he not founded, with exceptional munificence,[1] a university that is becoming famous? Yes, indeed; but when my Cyclopædia was published, he had not founded a university; he was nothing but a rich man.

It will be remembered that the Hebrews, Greeks, Arabs, Persians, and others, regarded the number *seven* as sacred, symbolizing perfection. The golden candlestick of the Tabernacle had seven branches. Now I am interested in this venerable number. If I were to name a college, I should certainly prefer a word of seven letters. "Amherst" is composed of seven letters, and so is "Bowdoin," and "Rutgers," and "Oberlin," and "Cornell," and "Harvard."[2] Is it two hundred and thirty-four years since Mr. Harvard founded that college near Boston? His name has grown more and more illustrious to this very hour. I dismiss this topic with a quotation from the tragedy of "Julius Cæsar.' Cassius impatiently exclaims to his friend Brutus —

> "*Brutus*" and "*Cæsar*":[3] what should be in that "Cæsar"?
> Why should that name be sounded more than yours?
> Write them together, yours is as fair a name;
> Sound them, it doth become the mouth as well;
> Weigh them, it is as heavy; conjure with 'em,
> "Brutus" will start a spirit as soon as "Cæsar."

Let me say again — Give thanks for the iron-kings.

Thankfulness Supreme for the Agency of Iron in Civilization. — One point more. Thank God for Iron as a conspicuous and indispensable agent in the advancement of civilization. There are two forces[4] which have wrought together in effecting human progress; I mean Iron and intellect. The intellect has done the contriving, and its contrivances have been executed through the agency of Iron. This metal is the instrument by which modern

[1] From the assistant treasurer of the institution, I have a polite note under date of December 7th, which communicates the following: "Mr. Cornell has recently signified his intention of giving the University another $500,000, which will make the Founder's fund, $1,000,000. The University farm is also a gift from Mr. Cornell, which with other gifts (too numerous to mention) amount to at least $200,000 more."

[2] I have a list of thirty-nine other collegiate institutions in the United States whose names are composed of seven letters!

[3] In the recital of this quotation from Shakespeare, *Harvard* was substituted for "Cæsar," and ANOTHER NAME for "Brutus."

[4] There is a third force — Christianity — which has had a hand in the matter.

civilization has been achieved. I look upon this as the lordliest fact that is relative to Iron.

In an infantile state of society there are few wants, and those are very simply supplied, so that there would be little care about better tools. And then the ore of Iron is so difficult of reduction — more refractory indeed than the ore of any other metal — it is so difficult of reduction, I say, that an infant people, with their rude processes, would be induced to content themselves with limited supplies. But as they rise a little in the scale of intelligence, their wants multiply a little, and they acquire a little enterprise in procuring implements, as well as a little new skill in reducing an ore and working its metal.

For example: while men are content to live in huts of turf or stone, they do not miss the carpenter's tool-chest. But when they aspire to live in log-houses, they have urgent use for metallic implements, rude ones at least; and when they aspire to elegant residences, they *must* have a variety of edged tools, with nails and hangings and fastenings. At every step in this progress, there is an increasing demand for Iron, and the progress could not be continued without the Iron, nor without an increase of it.

Then, again, while men are content to dress in the skins of wild animals, they can easily dispense with metallic conveniences for sewing; but in process of time, steel needles will be required imperatively, and at length there will come a demand for all the Iron and steel of the sewing-machine.

While people peregrinate on foot or on the backs of camels, they have scarcely any wants that call their attention to things ferruginous; when the saddle-and-bridle era arrives, they have serious needs that Iron might supply; when they aspire to carriages, the springs, tires, braces and bolts will doubtless be the product of an ore-bed; and when the era of rail-cars arrives, what a world of metal for the track, engines, car-wheels and axles.

These instances may be generalized into the statement that *the extent to which Iron is consumed by any community, measures the progress of that community in civilization.* Taking all the races of the world together — savage, barbarous, half-civilized, civilized and enlightened — the average consumption of Iron per head each year is thirty pounds; while in the United States there is an average of one hundred and fifty pounds, and in England, of two hundred. During the recent years, the progress in arts, manufactures, and trades has been more rapid than ever before.

Seventeen years ago, the average quantity of Iron consumed per head throughout the world was only seventeen pounds.[1]

I am superlatively interested in this debt which civilization owes to Iron. It is the ladder — the absolute *sine qua non* — by which our world has mounted to great heights of privilege. Were there no Iron, though gold had been as abundant as Iron is, men could never have emerged from barbarism.

Edged tools are a primary condition of any considerable advance in the career of improvement, and a cubic yard of gold, a cubic mile of it, could never yield one knife-blade.

Iron, then, with the coöperation of intellect, has brought us up out of barbarism to the age of elegant homes, beautiful garments, and lovely instruments of music, the age of sun-pictures and printing-presses, the age of sewing-machines and mowers and reapers, the age of steam-engines and railroads, of steam-ships and telegraphs. And Iron is the instrument by which the race is to *continue* its progress. It is the opinion of a writer in the "Popular Science Monthly," that the whole world will ultimately require as much Iron per head as we now consume in the United States, when a total annual production of 70,000,000 tons will be required, — five times the product of the year 1872. And so it will come to pass that the Golden Age[2] which the poets have sung of will be an Iron Age, will it not?

Soli Deo Gloria.

It is not surprising to me that the heathen of former times either attributed the discovery of Iron to their gods, or elevated the men who were supposed to have done it, to the rank of gods. We, too, recognize the merit of such benefactors, acknowledge our indebtedness to them, and hold their names in pleasant and honorable remembrance. That genius who, in the days of Adam, *facile princeps*, invented the forging of Iron — Tubal-Cain; the father of the modern iron-trade, he who introduced, in 1783–4, the invaluable processes of puddling and rolling — Henry Cort[3];

[1] In the United States, 84 lbs.; in Great Britain, 144.

[2] Don't apply your rhetorical test-paper to this allusion. The real Golden Age is not to be sought in the past, and it will consist of something else than the down on a butterfly's wing.

[3] Cort was allowed to starve, though he spent £20,000 in perfecting those inventions which have conferred upon Great Britain a property equivalent to £600,000,000.— *Encyc. Brit.*

that expert whose steam-engine offers power for pumping mines, raising ores, producing copious and regular blasts, and moving the machinery of forges and rolling-mills — James Watt; he who in 1824 suggested the heating of the furnace-blast, by which two thirds of the fuel is saved and the production increased four-fold — Beaumont Neilson; he who supplemented Neilson's invention in 1837 — applying the waste gases that escape from the top of the furnace to the heating of the blast — Faber du Four; the master who taught in 1856 how to convert the product of the blast-furnace into wrought-iron and semi-steel without fuel and with great saving of time and labor — Henry Bessemer; — the debt which we owe to these worthies, and many others, some of them known, perhaps more of them unknown, we would not, shall not, forget nor undervalue. Yet, you and I, citizens of Christendom, cannot *deify* Tubal-Cain, Cort, Neilson, and Bessemer. Recognizing the *infinite* ONE, we have no room for "gods many." Ours is the better, the sublimer part, of rendering heartiest thanks and highest honors unto Him *who endowed our benefactors with their surpassing intelligence, and who also imparted to Iron its invaluable and wondrous properties.*

Therefore, unto the august Creator, the bountiful Provider, the sagacious and benignant Arranger, be rendered and ascribed, as is most due, all praise, might, majesty and dominion, both now and ever. Amen.